

Does Today's FCC Have Sufficient Decision Making Throughput to Handle the 21st Century Spectrum Policy Workload?

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Abstract:

Today's FCC is not as well structured to handle the reality of its spectrum policy workload as the early Commission was and may not be even keeping up with workload. Indeed, there is increasing evidence that "triage" is a key issue in spectrum policy. That is the nontransparent decision to even address an issue is a major determinant of its outcome. This could be both deterring capital formation for new spectrum technology R&D as well as creating real risks for incumbent licensees since emerging interference issues that need rulemaking or nonroutine action are not getting resolved in a timely way.

In 1934, the new FCC took a page from the structure of the Interstate Commerce Commission (ICC), one of its predecessors, and divided the then 7 commissioners into 3 "divisions" that could operate independently in the policy areas of telephone, telegraph, and radio. There was no Administrative Procedures Act ("APA") so rule deliberations were far simpler than today. The maximum frequency in routine use was 2 MHz and the modulation choices were just AM and radiotelegraphy. In the early days, a few of the commissioners had technical experience in spectrum issues.

Today we have the APA and nearly 70 years of court decisions that make rulemaking much more complicated. We have 5 commissioners that only make decisions *en banc* with virtually no §5(c) delegation to staff on emerging issues. Allocations go to 275 GHz, but service rules have been stuck at a 95 GHz limit since 2003. The selection process for commissioners appears to be focused on nonspectrum and nontechnical issues.

The result of all these factors is long drawn out deliberations on both new technology issues and on resolution of merging interference issues. While the US' economic competitor nations often use "state capitalism" as a key issue in spectrum policy by subsidizing chosen new technologies and then cooperating to remove national and international spectrum policy limits for them, US entities in spectrum R&D often face both a lack of funding and an indifferent FCC (as well as NTIA - if access to G or G/NG spectrum is at issue).

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The paper looks at a variety of spectrum policy issues FCC had dealt with since 2000 and examines the delays involved and their impacts. The issues include new technology issues such as the TV White Space, the FWCC 43 GHz petition and the Battelle 105 GHz petition as well as emerging interference issues such as police radar detector/VSAT interference, cellular booster-related interference, and FM broadcast/700 MHz LTE interference. The time lines of such deliberations will be reviewed as well as the likely impact of these timelines on the business plans of FCC regulatees.

Finally possible options to improve FCC throughput that are both feasible within existing legislation and consider approaches successfully used in foreign spectrum regulators will be discussed.

Introduction

This paper reviews the ability of FCC to deal with spectrum policy issues both when it was created in 1934 and today. Much of the style and format of today's spectrum regulations and FCC's deliberation style were created at its very beginning by FCC and its predecessors. While these approaches to developing regulations may have been adequate then in keeping up with technology and demands, recent backlogs and delays raise serious questions about whether they are still adequate today. The explosion of spectrum technology after World War II happened at the same time that the Administrative Procedures Act complicated the adoption of regulations and ensuing case law slowly complicated it more in an ever increasing way.

This paper does not criticize any FCC spectrum decisions that were actually made, rather it focuses on the delays involved and their impacts. This spectrum policy throughput issue has developed over 2-3 decades under many chairmen from both parties and thus is not a partisan issue.

While the present congressional hyperpartisanship and gridlock makes new legislation to address this issue unlikely, this paper describes several options that could be implemented within existing legislation. However, low funding of FCC spectrum policy activities remains a major issue – one that industry appears to have had little interest in to date.

What has changed since 1934?

In this section we will discuss that legal and technology changes that have happened since 1934. This is to show that while the FCC may have been able to keep up with its

technical Title III jurisdiction in its early years, these changes have made it increasingly challenging to keep up today as FCC is currently operating.

Organization Issues

The Federal Communications Commission was created by the Communications Act of 1934¹ that merged the previous Federal Radio Commission, created in 1926, with the telephone and telegraph jurisdiction of the Interstate Commerce Commission (ICC), created in 1887. At its creation FCC had 7 commissioners. (The number decreased to 5 during the Reagan Administration.) The Commission commenced operation on July 11, 1934 when all its commissioners were sworn in and at the time had 121 employees at the “seat of government” and 112 employees “in the field service”. The Commission’s first annual report states:

“On July 17, 1934, the Federal Communications Commission organized its divisions in keeping with the Communications Act. Three Divisions (i.e. Broadcast, Telegraph and Telephone), composed of two members each, were created with the Chairman serving *ex officio* as a member of each Division”.²

The structure of the divisions was clarified in FCC Order No. 1, also adopted on July 17, 1934. The Order clarified that each division consisted of the Chairman plus 2 other commissioners. It went on to state that each division “shall have and exercise jurisdiction over all matters relating to or connected with (its respective industry)” and stated:

The whole Commission shall have and exercise jurisdiction over all matters not herein specifically allocated to a division; over all matters which fall within the jurisdiction of two or more of the divisions established by this order; and over the assignment of bands of frequencies to various radio services. In any case where a conflict arises as to the jurisdiction of any division or where jurisdiction of any matter or serviced is not allocated

¹ 48 Stat. 1064 (<http://www.legisworks.org/congress/73/publaw-416.pdf>)

² *First Annual Report of the Federal Communications Commission to the Congress of the United States For the Fiscal Year 1935* at p. 1-2 (https://transition.fcc.gov/Bureaus/Mass_Media/Databases/documents_collection/annual_reports/1935.pdf)

to a division, the Commission shall determine whether the whole Commission or a division thereof shall have and exercise such jurisdiction.”³

Where did this concept of dividing the commissioners into 3 parallel “divisions” or “minicommissions” come from? From ones of its parents: the ICC! Prior to 1917 ICC functioned only *en banc* like today’s FCC, but as ICC explained in 1920:

By an act of Congress approved August 19, 1917, we were authorized to divide our membership into as many divisions as might be deemed necessary, and to assign or refer any of our work, business, or functions to a division for action. Divisions so constituted were, by the act, given authority by a majority thereof to prosecute and conclude matters so assigned or referred with the same effect as if the resulting action had been taken by the Commission, subject to rehearing by the Commission itself.”⁴

The ICC started with 3 divisions with stated responsibilities in 1927 and by 1920 had increased the number to 5. The number of ICC commissioners changed over the years starting at 7, reaching 11 in the 1940s⁵, and ending - at its demise in 1996 - at 5. While FCC does not have the specific provisions of the 1917 ICC legislation that allowed its parent to divide its work among groups of commissioners, it actually had *broad* provisions in Section 5(c) of the 1934 Act which remains in its original wording today. These provisions allow the Commission to delegate most of its functions to a “panel of commissioners, an individual commissioner, an employee board, or an individual employee” with the Commission

³ FCC Order No. 1, July 17, 1934

(https://transition.fcc.gov/ftp/Bureaus/Mass_Media/Databases/documents_collection/or19340717.pdf)

⁴ 34th Annual Report of the Interstate Commerce Commission, December 1, 1920

(<https://books.google.com/books?id=mgEyAQAAMAAJ&pg=PA4&lpg=PA4>)

⁵ P. S. Dempsey, “The Rise and Fall of the Interstate Commerce Commission: The Tortuous Path From Regulation to Deregulation of America's Infrastructure”, *Marquette L. Rev.*, Vol. 95, No. 4, p. 1151-1189, 2012 (<http://scholarship.law.marquette.edu/cgi/viewcontent.cgi?article=5129&context=mulr>)

retaining *en banc* review/reconsideration rights.⁶ The division structure of the FCC was abolished on November 13, 1937 after

“it was found that to subdivide a small commission in such a manner had a divisive (sic) effect and was not conducive to cooperation and mutual understanding among the members of the Commission”.

Today’s limited delegations of authority in Part 0, Subpart B of the Commission’s Rules were adopted pursuant to the terms of §5(c) and delegate limited powers to various bureau and office chiefs as well as the Defense Commissioner. (In theory any commissioner could be designated as the Defense Commissioner, but for more than 20 years only the Chairman has held this position.)

Impact of 1946 APA

The Administrative Procedures Act⁷ (APA) that governs rulemaking at FCC and all other regulatory agencies was enacted June 11, 1946 to strengthen the system of checks and balances for the large number of regulatory functions that appeared during the New Deal. APA served a useful purpose in making agency rulemaking less arbitrary and more transparent, and in requiring public input. Before the APA there were few checks and balances on both agency rulemakings and adjudications.

Most spectrum policy issues, especially those for new technology, are rulemakings at FCC that now are governed by both the original Communications Act and the §553 of the APA. But prior to the enactment of the APA, FCC’s procedures to adopt rules were much simpler and certainly much less paperwork intensive as can be seen in the short length of early decisions. But the 357 words of §553 are *no longer* the key determinants

⁶ 47 U.S.C. 155(c)

⁷ 5 U.S.C. § 500, 60 Stat. 237

of what it takes to adopt and update rules. In our common law system the implications of the APA are not this modest text but the nearly 70 years of court precedents that have determined what is meant by phrases such as “either the terms or substance of the proposed rule or a description of the subjects and issues involved”.⁸ While the “full faith and credit of the APA” may be necessary in the public interest to safeguard rules affecting pharmaceutical approval, social security eligibility, and bank regulation, their application to rules that allow the introduction of new technology is probably not what Congress intended in 1946. Nevertheless, FCC has no choice but to use the same APA that EPA uses although at least one author has called for Congress to grant FCC a limited APA simplification for new technology issues.⁹ This proposal was made in response to an FCC Notice of Inquiry captioned “Fostering Innovation and Investment in the Wireless Communications Market”¹⁰. That NOI itself has never been acted on by FCC in the past 6 year despite the fact that its announcement by FCC included this statement of its importance:

“Innovation in wireless, an increasingly significant part of the communications sector, can be an engine for near-term economic recovery and long-term economic growth. In furtherance of this goal, the NOI seeks comment broadly on all ideas that will foster wireless innovation and investment.”¹¹

The inaction of FCC on this NOI with its lofty spectrum goals is a very visible symptom of FCC’s present inability to deal with its spectrum policy agenda.

⁸ 5 U.S.C. 553(b)(3)

⁹ Comments of Mitchell Lazarus, Docket 09-157, September 30, 2009 at p. 10-11 (<http://apps.fcc.gov/ecfs/document/view?id=7020039921>)

¹⁰ *Notice of Inquiry*, Docket 09-157, August 27, 2009 (https://apps.fcc.gov/edocs_public/attachmatch/FCC-09-66A1_Rcd.pdf)

¹¹ FCC Press Release, “FCC ANNOUNCES WIRELESS INNOVATION AND INVESTMENT NOTICE OF INQUIRY”, August 27, 2009 (https://apps.fcc.gov/edocs_public/attachmatch/DOC-293118A1.pdf)

Technology & Industry Changes

The status of the spectrum-related industries at the Commission's beginning is well documented in the Commission's first annual report.

- On June 30, 1935 there were 632 broadcast stations, 1011 experimental stations, and 303 land mobile licenses – almost all of which were public safety.
- The highest frequency in nonexperimental use was “30,000 kc” or what would be called today 30 MHz.
- In the whole country there were only 20 directional antennas because at the frequencies in use then such antennas would have to be very large. While the pioneering Yagi-Uda directional antenna¹², the basis of most TV receiver antennas and many other directional antennas, has already been invented and patented in Japan and the US by the 1930s. This type of directional antenna technology was not in practical use until World War II and was little known in the 1930s. Thus spectrum policy issues related to antenna technology and issues such effective radiated power were of no concern to the early FCC.
- Finally, the only radio modulations available for consideration at the early FCC were continuous wave (CW) radio telegraphy and amplitude modulation (AM). FM was invented in the early 1930s and would not become known commercially until a presentation at FCC on June 17, 1936¹³. It did not come into wide commercial use until after World War II.

Thus spectrum policy deliberations at the early FCC had many fewer dimensions than today and there were 3 “mini-FCCs” to split the work load of these deliberations and they could work with legal procedures that were much more expeditious than today's which must comply with both the 1946 APA and the case law that now accompanies it.

It is indeed ironic that just as an explosion of new wireless technologies and ever increasing frequencies became available in the aftermath of World War II the APA appeared and started, slowly at first but more and more as its case law accumulated, decreasing the productivity of FCC spectrum deliberations. As is shown in the next section there is now a major mismatch between FCC's productivity in technical spectrum

¹² https://en.wikipedia.org/wiki/Yagi-Uda_antenna

¹³ https://en.wikipedia.org/wiki/Edwin_Howard_Armstrong#FM_radio

policy *as it is presently operating and funded* and the requirements of today's spectrum related

State Capitalism in Other Countries' Spectrum Policy

Many of the national economic competitors of the US engage in what could be called “state capitalism” with respect to spectrum-related industries and spectrum policy for fostering their communications technology industries. These countries target specific new spectrum technologies and services, subsidize their R&D with government spending, and then adopt rules granting market access in their territory for the technology that was subsidized and restricting market access for alternative technologies that were not subsidized. Once public funds have been invested in radio technologies, the natural tendency of government entities to make their projects successful leads to few doubts about regulatory approval for the new radio technology. Thus industrial participants in such a state capitalism project in these countries face little or no “regulatory risk”, in stark contrast to US firms needing nonroutine FCC spectrum approvals for petitions or rulemaking. Europe's approach to GSM and long restrictions against alternative technologies is one well known example. But this policy also applies to other spectrum system where interoperability is not an issue, such as the present European monoculture for the DECT cordless telephone standard developed in Europe.

Two examples of such state capitalism are the government support of millimeterwave technology for 5G cellular in the EU, China, Japan, and Korea that is document in a recent FCC pleading from NYU WIRELESS¹⁴ and the EU and German

¹⁴ Reply Comments of WIRELESS, Docket 14-177, January 13, 2015, at p. 8-14 (<http://apps.fcc.gov/ecfs/document/view?id=60001013322>)

support for high speed fixed links above 200 GHz, frequencies for which FCC has no service rules at present and appears to be trying to avoid even deliberating on¹⁵!

State capitalism is not our system and there is little or no support for it becoming our system, but we have to recognize what our competitors are doing and make sure our regulatory system does not operate in a way that puts us at a competitive disadvantage. In order to compete on a somewhat level playing field with firms in countries with state capitalism-based spectrum policy, US firms need timely transparent decisions on market access for new spectrum technologies in order to attract investors. Qualcomm got the green light from FCC for its radical CDMA technology 2 years after its incorporation in 1985. Such timeliness is unlikely today as discussed below.

Spectrum Policy Productivity Shortfall

Delegation of Authority Limits

The path started down by FCC in the 1930s leaves most policy decisions to the Commission to decide *en banc* and has limited delegated authority to the staff, thus making very sparing use of the options conveyed by §5(c) once the 3 divisions of commissioners were abolished in 1937. For example, the power delegated to the Chief, Wireless Telecommunications Bureau by §0.331 with respect to rulemakings, such as those needed to allow a new technology or to create service rules in a new band (whether or not it poses any interference risk to any incumbent), state:

“The Chief, Wireless Telecommunications Bureau shall not have the authority to act upon notices of proposed rulemaking and inquiry, final orders in rulemaking proceedings and inquiry proceedings, and reports arising from any of the foregoing except such orders involving ministerial conforming amendments to rule parts, or orders conforming any of

¹⁵ NPRM, Docket 14-177, at fn. 64 (https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-154A1_Rcd.pdf)

the applicable rules to formally adopted international conventions or agreements where novel questions of fact, law, or policy are not involved.”¹⁶

The Chief, Office of Engineering and Technology (OET) has the following limitations in his delegated authority with respect to issues that must be referred to the Commission *en banc*:

“Any other petition, pleading or request presenting new or novel questions of fact, law, or policy which cannot be resolved under outstanding precedents and guidelines. Petitions and other requests for declaratory rulings, when such petitions or requests contain new or novel arguments not previously considered by the Commission or preset facts or arguments which appear to justify a change in Commission policy.”¹⁷

The delegations to other bureau/office chiefs have similar limitations that focus on the *novelty* of the issue involved not whether it is controversial or if it will adversely impact any party or if the timeliness impact of consideration by the Commission *en banc* is cost effective in any public interest manner.

In a recent decision on the Commission’s Equipment Authorization Program, the delegated authority of the Chief of OET was enlarged marginally to allow updating of editions of references in the FCC Rules to voluntary standards, e.g. ANSI standards, that are incorporated into the rules by reference. The decision stated:

This process will permit us to better keep pace with industry standards than if the Commission were required to complete a full rulemaking proceeding for every widely-accepted and expertly-considered update to references in our rules regarding equipment measurement practices.¹⁸

However, even this modest increase was met with concerns at the Commission level. The decision goes on to say

Finally, we recognize that it is possible that some standards update decisions will be more appropriately considered by the full Commission. Thus, in the event that parties provide convincing evidence that the proposed use of an updated standard would, in fact, raise

¹⁶ 47 C.F.R §0.331(d)

¹⁷ 47 C.F.R. §0.241 (a)(1)(ii)(3),(4)

¹⁸ *Report and Order*, Docket 13-44 (December 30, 2014) at para. 87 (https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-208A1_Rcd.pdf)

major compliance issues, we direct OET to refer the matter for review and decision by the Commission.¹⁹

In addition, one of the commissioners released a separate statement dissenting to this part of the decision and calling it a “questionable delegation” and stated concern about “depriving Commissioners of the right to vote”²⁰. The concerns of this commissioner get to the heart of the issue: is there a “right to vote” for every commissioner on every policy decision and does this right exist even if implementing it means that the Commission can not deal with all its work load and as a result slows the introduction of new Title III technology and damages US competitiveness? While this may have been a practical approach in the 1930s, is it practical today?

We note that, by contrast, the Nuclear Regulatory Commission (NRC) does not condition its delegations of authority to senior staff under its counterpart²¹ of Section 5(c) to prevent staff from acting on all “novel” issues. For example, the Director of NRC’s Office of Nuclear Reactor Regulatory has among his delegated authorities the ability to make “amendments to licenses changing the technical specifications for utilization and production facilities” and to

“issue orders for imposing requirements and other appropriate orders for modification, suspension, and revocation of licenses, concerning: (a) the manufacture, construction, and operation of utilization and production facilities”²²

The present multiple uses of the word “novel” in FCC’s Part 0 enumeration of delegated authority prevents staff from dealing in a timely way with issues that arise from inevitable and desirable technical innovations and which do not have adverse impacts on any party.

¹⁹ *ibid.*

²⁰ <https://www.fcc.gov/article/fcc-14-208a2>

²¹ 42 U.S.C. §2201(n), §161(n) Atomic Energy Act of 1954
(<http://pbadupws.nrc.gov/docs/ML1327/ML13274A489.pdf#page=241>)

²² NRC Manual, Chapter NRC-0123-03 (<http://pbadupws.nrc.gov/docs/ML0414/ML041400069.pdf>)

Mass Dismissal of “Stale” Proceedings to Manage Backlog

On December 22, 2014 the FCC Blog announced that as part of the Process Reform Streamlining Initiative:

“Today, the Consumer and Governmental Affairs Bureau (CGB), working with the Bureaus and Offices, is releasing an order closing an additional 751 dormant dockets, bringing the total number of dockets closed this year to well over 1,500.”²³

This is not the first time FCC has dismissed a large number of “stale” proceedings

to clear its backlog, yet the Commission never examines why the backlog grew so large and how such a growth could be prevented in other ways. Many of these dismissed proceeding were indeed moot with the passage of time, however, they may not have been moot if they had been decided in a timely manner. While it might be argued that the decisions not to spend Commission resources on some of these issues early in their pendency was good management of limited Commission resources, making such “triage” a key part of policy deliberations create major transparency issues. Such triage decisions are not publicly announced²⁴ and lack potential for appeal for reconsideration within FCC and complicate any court remedies except a *mandamus* petition that is difficult to obtain where there is no explicit statutory deadline²⁵.

²³ <https://www.fcc.gov/blog/update-process-reform-streamlining-initiatives>

²⁴ A notable exception was the August 2010 communication from someone at FCC to M2Z Networks, Inc. and its backers that the commission was dropping consideration of its concept for use of the AWS-3 band. This statement was later confirmed in a public statement by the Chief, Wireless Telecommunications Bureau, but no formal Commission action was ever taken. “Plan for nationwide free wireless broadband finally shot down”, *ars technica*, September 1, 2010 (<http://arstechnica.com/tech-policy/2010/09/plan-for-nationwide-free-wireless-broadband-finally-shot-down/>), “What's Next for M2Z?”, *Wireless Week*, September 2, 2010 (<http://www.wirelessweek.com/blogs/2010/09/whats-next-m2z/>)

²⁵ Congressional Research Service, “Administrative Agencies and Claims of Unreasonable Delay: Analysis of Court Treatment”, March 21, 2013 (<https://www.fas.org/sgp/crs/misc/R43013.pdf>)

The rulemaking part of FCC is - in the jargon of queuing theory - a “single server queue” as shown below:

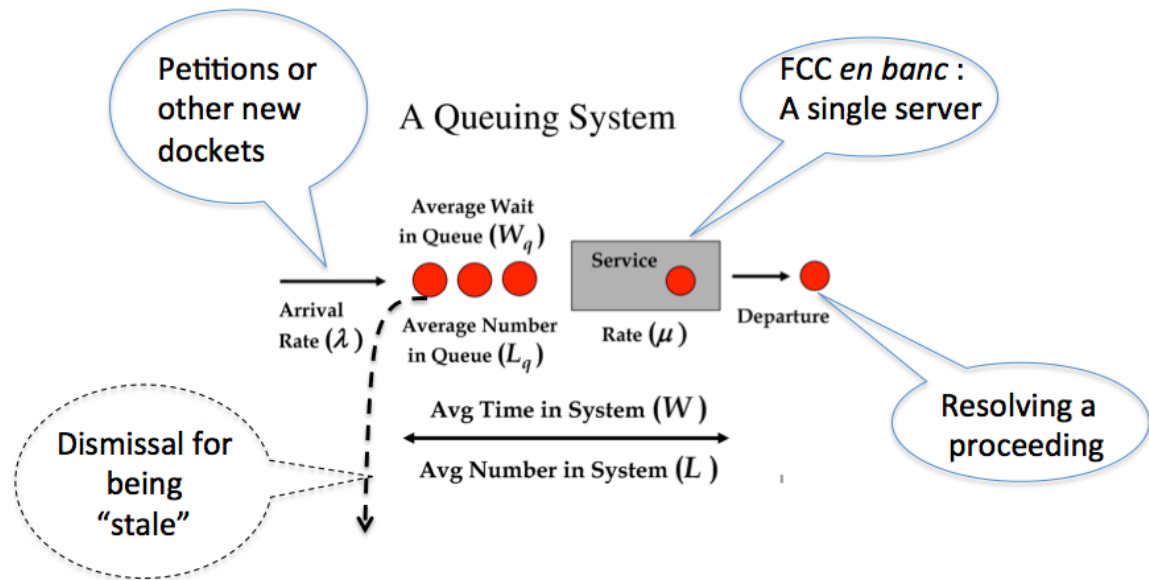


Figure 1: Single server queue model of FCC²⁶

FCC is modeled as a single server because it is similar to a bank with only one teller and all customers seeking interaction must wait for the attention of the one teller.

However, unlike a bank where customers expect first in first out (FIFO) treatment, the ordering/prioritization of FCC actions is certainly not FIFO – which in itself is a real transparency issue at FCC. However, the length of the queue/backlog is independent of FIFO and basically depends on the ratio of the arrival rate λ to the service rate μ . While in queuing theory this usually implies Poisson arrival rates and exponential service times, in general if $\mu < \lambda$ queues will build up indefinitely due to undercapacity. The dotted line shows the way FCC “manages” this issue at present by regularly dismissing hundreds or thousands of pending dockets for being stale, analogous to managing bank

²⁶ https://prezi.com/l_c3jiqjupi5/copy-of-copy-of-untitled-prezi/

queuing by having customers in bank teller queues starve to death while waiting for service: it works **but is it really desirable?**

We observe that the Patent and Trademark Office (PTO) has explicit rules²⁷ for dismissing patent applications that have become what the FCC calls “stale” while FCC has not comparable published criterion. For new spectrum technology an FCC waiver request or petition for rulemaking is as vital as a patent application for the innovator. But it can linger for years without Commission action and then be dismissed with hundred of other “stale” proceedings.

Oddly, when FCC dismisses large numbers of proceedings it describes such action as desirable and effective.²⁸ FCC never seems to ask why did these proceedings become stale or even tell parties appearing before FCC what is necessary to keep a proceeding from becoming stale! Monthly filings? Quarterly filings? Filings in a year by more than x parties? Minimum number of *ex parte* meetings/year? What does it take to prevent a proceeding from becoming stale?

Is FCC required by statute to be like the Patent Office and quietly wait for new spectrum policy ideas to show up at its doorstep and then handle them as time permits? At least the Patent Office has clear procedures for such dismissals of stale applications. FCC is required by both §7(a) “to encourage the provision of new technologies and services to the public” and by §303(g) to “generally encourage the larger and more effective use of radio in the public interest”. A major mismatch of decision making throughput to the work load defeats these statutory goals.

²⁷ 37 C.F.R. 1.134,135

²⁸ <https://www.fcc.gov/blog/update-process-reform-fcc>

Examples of FCC Spectrum Policy Backlogs

“The Lazarus 11”

Mitchell Lazarus is a distinguished communications attorney, now semi-retired, who has often represented clients with innovative wireless technologies. In his *pro se* Docket 09-157 comments²⁹ he gives 11 examples of technical rulemaking or waiver proceedings from the time period when the comments were filed. He also included with his comments an article he had published in which he which explains many of the causes of such delays and their impact on innovation³⁰. He also indicated

“All of these proceeding are “benign” in that the proponents fully addressed any serious opposition. That is, the Commission did not impose any restrictions other than those offered by the applicant.”

²⁹ Mitchell Lazarus, *op. cit.*

³⁰ Mitchell Lazarus “Radio's Regulatory Roadblocks: How the FCC slows new wireless technologies - and what to do about it”, *IEEE Spectrum*, Vol. 46, No. 9, p. 42 (September 2009) (<http://spectrum.ieee.org/telecom/wireless/radios-regulatory-roadblocks>)

The 11 examples given by Lazarus are:

Docket No.	Request	Start	End	Duration
WT 04-143	rulemaking – adding narrower bandwidths to 18 GHz fixed service band	05/04/2001 ^a	12/29/2006	66 mos.
ET 98-156	rulemaking – directional unlicensed power at 24 GHz	10/20/1997	02/13/2002	52 mos.
WT 07-54	rulemaking – smaller antennas in 11 GHz fixed service band	07/14/2004	10/31/2007	39 mos.
ET 99-231	rulemaking – unlicensed Wi-Fi “g” standard (digital modulation devices)	02/17/2000 ^b	07/25/2002	27 mos.
ET 06-195	waiver – UltraVision Security Systems perimeter security device	10/06/2006	11/20/2008	25 mos.
ET 04-373	waiver – SafeView security screening device	08/18/2004	08/04/2006	24 mos.
WT 09-114	rulemaking – conditional licensing on additional channels in 23 GHz fixed service band	11/07/2007	(pending)	23 mos. (to date)
ET 00-47	rulemaking – software-defined radios	03/21/2000	02/04/2002	22 mos.
WP 08-63	waiver – ReconRobotics surveillance robot	01/11/2008	(pending)	20 mos. (to date)
WT 09-114	rulemaking – adding wider bandwidths to 6 GHz fixed service band	02/04/2008	(pending)	20 mos. (to date)
WP 09-2	waiver – L-3 CyTerra public safety radar	02/22/2008	(pending)	19 mos. (to date)
NOTES (a) Date of <i>ex parte</i> statement in IB Docket No. 98-172 proposing 18 GHz channel plan. (b) Date on which Wi-LAN, Inc. filed an Application for Review of denial of certification of an OFDM device under § 15.247. The Commission effectively treated that application as a petition for rulemaking. <i>Spread Spectrum Devices</i> , 16 FCC Rcd 10036 (2002).				

Table I: “The Lazarus 11”

Why did these proceedings take years to be resolved? Despite being uncontroversial, they also did not have a broad base of support and if the demand for spectrum decision making at FCC exceeds capacity, then something has to go to the back of the queue! But sometimes such proceedings are handled in a timely way and sometimes they are not, leading again to transparency issues.

Wireless Innovation NOI – Docket 09-157:

As mentioned previously, this proceeding was launched with great fanfare early in the Genachowski chairmanship. It stated boldly:

“[W]e are aware that Commission policies and processes can also hinder the progress of innovation and investment. At times, we have seen innovators subjected to lengthy regulatory processes . . . that can be an obstacle to progress in the wireless arena. A goal of this inquiry is to initiate a dialogue with stakeholders

on how to remove any unnecessary impediments caused by the Commission's policies and rules."³¹

This *NOI* generated hundreds of comments and dozens of *ex parte* filings. It promised to address key issues in wireless innovation but apparently is dead in the water at present, probably awaiting the Commission's next batch of dismissals of "stale" proceedings.

"Cellular Booster"/Docket 10-4 Interference Issue

Cellular boosters are devices used in areas with poor cellular coverage to extend that coverage and make it more reliable. Depending which side one talks to, they either were permitted by longstanding cellular equipment rules or were wantonly illegal. However, the Commission's Equipment Authorization Program was approving them routinely starting around 2000 under an interpretation of the Rules that, at best, lacked transparency. The first generation of these devices sometimes oscillated in a way similar to what happens in an audio system when a microphone is held too near a speaker. These oscillations caused harmful interference to cellular base stations. On May 1, 2006 CTIA made a presentation to the FCC staff on the issue, presented a white paper on the issue, and stated clearly "**FCC action is urgently needed**".³² On January 6, 2010, 3½ years later, FCC *finally* sought public comment on a series of petitions on the issue dating back to August 2005 including a CTIA petition from November 2007.³³ An NPRM was initiated on April 5, 2011³⁴, almost 5 years after the original CTIA plea for

³¹ Docket 09-157 *NOI* at para. 5

³² http://files.ctia.org/pdf/filings/FINAL--CTIA--Jammers_Petition_for_Declaratory_Ruling.pdf

³³ FCC Public Notice, WIRELESS TELECOMMUNICATIONS BUREAU SEEKS COMMENT ON PETITIONS REGARDING THE USE OF SIGNAL BOOSTERS AND OTHER SIGNAL AMPLIFICATION TECHNIQUES USED WITH WIRELESS SERVICES, January 6, 2010 (https://apps.fcc.gov/edocs_public/attachmatch/DA-10-14A1_Rcd.pdf)

³⁴ NPRM, Docket 10-4, April 5, 2011 (https://apps.fcc.gov/edocs_public/attachmatch/FCC-11-53A1_Rcd.pdf)

urgent action, and initial rules³⁵ were not adopted until February 20, 2013! Note this was almost 7 years after CTIA said action was “urgently needed”. While this delay hurt cellular carriers, and will continue to hurt them since the new rules grandfather existing equipment for 5 years, it also hurt the booster manufacturers. Regulatory uncertainty limited the manufacturers’ access to capital investments and the domestic manufacturers who had invested resources to solve the problem faced competition from Asian manufacturers whose less expensive products were still permitted although they had taken no steps to address the problem. Thus the delay became a **lose/lose situation** for **all** parties involved except the overseas manufacturers who continues to make equipment that contributed to the ongoing interference.

FM/LTE Interference Issue

This issue is a cousin in many ways to the Docket 10-4 issue. It involves the surprising fact that FM broadcast stations near 100 MHz sometimes cause interference to 700 MHz LTE cellular base stations nearby.³⁶ The *public* trail of this problem appears to begin more than 2 years ago on June 19, 2013 with the issuance of a Notice of Violation³⁷ (NOV) by the FCC’s Enforcement Bureau’s New York District Office to WKZE-FM in Salisbury CT. (It is unclear from the public record how long FCC has actually been aware of this issue.) The NOV alleges that WKZE’s signal on 98.1 MHz had an 8th harmonic at 784.8 MHz that was causing interference to a Verizon base station located approximately 500 feet away. Both FM broadcasters and cellular licensees can

³⁵ Report and Order, Docket 10-4, February 20, 2013 (https://apps.fcc.gov/edocs_public/attachmatch/FCC-13-21A1_Rcd.pdf)

³⁶ “Harmonic Convergence? FM Interference to 700 MHz LTE Service”, *CommLawBlog*, June 25, 2013 (<http://www.commlawblog.com/2013/06/articles/broadcast/harmonic-convergence-fm-interference-to-700-mhz-lte-service/>)

See also <http://www.marcus-spectrum.com/Blog/files/FM2LTEint214.html>

³⁷ http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-321765A1.pdf

cite Rule sections say that the other party is responsible for solving the problem and as a nonlawyer it is fair to say that the rules involved are ambiguous in this case. But what is striking here is that despite dozens or perhaps hundreds of cases of such interference, the Commission's only public statements on the problem have been obscure enforcement notices, none of which appear to have ever been resolved. Why has the usually aggressive CTIA been strangely silent in this case and rather low key in later phases of Docket 10-4? The author's hypothesis is that CTIA has been implicitly or explicitly told by the Commission staff that given the low throughput of spectrum policy decision making capacity at FCC, CTIA can choose between resolving future spectrum needs below 6 GHz or resolving interference issue, but can not get both.

Police Radar Detector/VSAT Interference (Docket 01-278)

Like the previous example of FM/LTE interference, Police Radar Detector/VSAT interference involves another type of interference that is counterintuitive and unexpected. Police radar detectors are nominally passive receivers intended to warn drivers of nearby police radars enforcing speed limits. (They are illegal in cars in 20+ states including Virginia.³⁸) The local oscillator (LO), a subsystem in the receiver, in many of the detectors at the time of this rulemaking generated a signal at 11 GHz that was combined with over-the-air signals arrival at the unit's antenna. While the 11 GHz LO signal was not *intended* to be radiated, it was radiated in the designs in several detectors resulting in interference to VSAT receivers at the same frequency.³⁹ While the NPRM is vague about when this problem was first noticed, the author has personal knowledge from his experience in FCC's former Field Operations Bureau that the problem was well known

³⁸ <http://www.radarbusters.com/State-Radar-Detector-and-Laser-Jammer-Laws-s/2412.htm>

³⁹ NPRM, Docket 01-278, October 2, 2001 at para. 11-12
(https://apps.fcc.gov/edocs_public/attachmatch/FCC-01-290A1.pdf)

and understood by both satellite operators and FCC *at least a decade* prior to the issuance of the NPRM.⁴⁰ (In the absence of FCC action on this interference, VSAT operators minimized use of the satellite transponders most susceptible to interference but as VSAT demand inevitably increased this became too burdensome and pressure for FCC action increased.)

So while the time from the NPRM to the initial rules⁴¹ in this proceeding was only 8 months, this simple chronology overlooks the greater than a decade “latency” before spectrum policy resources were able to focus on the problem. This latency is greater than the comparable latency in the Docket 10-4 case of 5 years from the first formal notification of CTIA about the problem to the issuance of the NPRM. There is no paper trail at FCC of when the VSAT problem was first noticed or when satellite operators first complained to FCC.

While immediate rulemaking should not be the response to every report of a new interference mechanism, these cellular booster and radar detector multiyear delays - both dealing with interference to major licensees – are a clear symptom of major throughput problems in the Commission’s spectrum policy deliberations.

“The War on Millimeterwave Spectrum”

This is a concept coined by the author⁴² to describe the Commission’s backlog on policy issues dealing with spectrum issues above 60 GHz. At present FCC spectrum allocations go up to 275 GHz, but specific service rules only go up to 95 GHz, with

⁴⁰ For example FEMA responders to the 1995 Oklahoma City bombing experienced interference to their emergency VSAT system they brought to the site, which was close to a major highway that was undamaged and still carrying traffic. While it was never proven this interference was due to radar detector emissions, it closely matched previous cases.

⁴¹ First R&O, Docket 01-278, July 12, 2002 (https://apps.fcc.gov/edocs_public/attachmatch/FCC-02-211A1.pdf)

⁴² <http://www.marcus-spectrum.com/Blog/files/category-mmw.html>

minor exceptions for Amateur Radio and ISM bands. Licensed or unlicensed systems can not be sold or used without such service rules. The 95 GHz limit was reached in October 2003 in Docket 02-146 and has not moved since.

As was discussed above, many of the US' national competitors engage in state capitalism in their spectrum technology industries. While these other countries are actively subsidizing R&D in millimeterwave technology development and planning applications⁴³, FCC's policy ambiguity in the area is discouraging private capital formation for this cutting edge technology due to excessive regulatory risk.

The "war" here consists of excessive FCC regulatory delay on the following millimeterwave proceedings:

Docket 10-236: Where FCC banned all experiments in bands with only passive allocations without any explanation, possibly due to a clerical error in placing a new sentence in the wrong rule section. This issue was finally resolved in a reconsideration order recently nearly 2½ years after the original decision although *no one* ever filed comments *at any point* of the rulemaking supporting this prohibition!

Docket 13-259: A petition from IEEE-USA⁴⁴ seeking a declaratory ruling technology greater than 95 GHz is presumptively "new technology" in the context of §7 of the Communications Act and thus entitled to timely deliberations like corporate mergers – although corporate mergers have no statutory entitlement.

Docket 13-84: An update of the Commission's RF safety rules that maintains the present 100 GHz limit for quantitative limits even though the underlying voluntary standard these than rules are based on now goes to 300 GHz. This creates another level of regulatory uncertainty for those developing millimeterwave technology.

Docket 10-253: Fixed Wireless Communications Coalition (FWCC) request to update antenna regulations for the 70/80 GHz bands whose present uses differs

⁴³ ETSI, "millimetre Wave Transmission (mWT): Applications and use cases of millimetre wave transmission", ETSI GS mWT 002 V1.1.1 (August 2015)
(http://www.etsi.org/deliver/etsi_gs/mWT/001_099/002/01.01.01_60/gs_mWT002v010101p.pdf)

⁴⁴ <http://apps.fcc.gov/ecfs/comment/view?id=6017474704>

from what was anticipated when the rules were drafted.⁴⁵ These changes were requested in 2012.⁴⁶

Reallocation of Spectrum for Commercial Mobile Radio Service (CMRS)

CTIA recently published a report stating that “it takes 13 years on average to reallocate spectrum for wireless (*sic*) use”. (Presumably by “wireless” they meant CMRS use since CTIA calls itself “The Wireless Association” although lexicographers have not fully endorsed this redefinition.) The following table is a summary of CTIA’s data:

SPECTRUM	BANDS	FIRST STEP	AVAILABLE FOR USE	FIRST DEPLOYMENT	APPROXIMATE TIME LAG
Cellular	824-849; 869-894 MHz	1970	1981	1983	13 years
PCS	1850-1920; 1930-2000 MHz	1989	1995	1995	6 years
EBS/BRS	2496-2690 MHz	1996	2006	2009	13 years
SMR	817-824; 862-869 MHz	1995	2012	2013	18 years
700 MHz	698-748; 746-806 MHz	1996	2009	2010	14 years
AWS-1	1710-1755; 2110-2155 MHz	2000	2006	2008	8 years
WCS	2305-2315; 2345-2355 MHz	1997	2012	2015	18 years
AWS-3	1695-1710, 1755-1780; 2155-2180 MHz	2002	2015	2017 (estimated)	15 years
AWS-4	2000-2020; 2180-2200 MHz	2003	2012	2017 (estimated)	14 years
600 MHz	TBD	2014	2016 (estimated)	TBD	TBD

Table 3: CTIA data on CMRS reallocations⁴⁷

Not shown in the table, though discussed in the underlying report, is the fact that many of these reallocations depended on converting Federal Government (G) spectrum

⁴⁵ <http://www.commlawblog.com/2015/04/articles/cellular/when-size-matters-smaller-can-be-better-in-antenna-design/#more-2115>

⁴⁶ <http://apps.fcc.gov/ecfs/document/view?id=7022028948>

A separate waiver request from an FWCC member on this antenna issue has never been put on public notice or dismissed.

⁴⁷ CTIA, “From Proposal to Deployment: The History of Spectrum Allocation Timelines”, 2015 (<http://www.ctia.org/docs/default-source/default-document-library/072015-spectrum-timelines-white-paper.pdf>)

into Non-Federal Government (NG) spectrum which was beyond the FCC's complete control due to the FCC/NTIA dichotomy resulting from Sections 301 and 305 of the Communications Act.⁴⁸ Needless to say, there is enough blame to go around between FCC, NTIA, and the federal agencies that try to dictate to NTIA their myopic visions of the national interest through their participation in the Interdepartmental Radio Advisory Committee (IRAC).

Options for Change

The challenge of the above mentioned CMRS reallocations is a major issue for FCC and is also a major contributor to the spectrum policy overload. These reallocations are the type of issues that made the drafters of the Communications Act call for a bipartisan commission of presidential appointees to control communications policy. But does that mean that these presidential appointees need hands-on micromanagement of **all** spectrum policy issues? It appears that this insistence for such detailed control by the 5 commissioners has resulted in the spectrum policy overload where productivity does not match the workload. Consider the recent decision mentioned above on reconsideration of the experimental rules.⁴⁹ Is there anything in this noncontroversial correction of the *Report and Order* adopted 2 ½ years earlier that really needed the attention of 5 presidential appointees? Did their attention to this decision add value to the process or merely delay it? Is it possible to improve the productivity of the FCC in spectrum policy by changing it from a single server queue to a multiserver queue? Can this be done with assuring that the issues needing the insight of presidential appointees gets such

⁴⁸ 47 U.S.C. 301,305

⁴⁹ MO&O&FNPRM, Docket 10-236, July 6,2015
(http://transition.fcc.gov/Daily_Releases/Daily_Business/2015/db0708/FCC-15-76A1.pdf)

attention while other more ministerial and technocratic issues get more expedite service?

In this section we discuss options for improving FCC productivity in spectrum policy.

Lazarus Suggestions

We previously included a table of delayed proceedings from Mitchell Lazarus' *pro se* filing in Docket 09-157. Mr. Lazarus also made several suggestions in those comments. Here are the five specific suggestions he made:

- Simplify procedures for technical proceedings that lack major social or economic impact.
- Apply streamlined treatment to proceedings for benign technologies.
- Curtail the *ex parte* process
- Release a brief supplemental NPRM on tentative decisions.
- Bifurcate non-controversial issues

Lazarus admits that his first suggestion probably needs new legislation in view of the APA and its case law. While this is a high hurdle, we note that on several occasions commissioners have suggested an exemption for FCC from some of the terms of the Government in Sunshine Act.⁵⁰ The remaining four suggestions may not require new legislation and could be implemented by the Commission if it so chooses.

IEEE-USA Suggestions

IEEE-USA⁵¹, the US element of the electrical engineering professional society submitted to the Commission a set of recommendations⁵² in November 2012 that attracted no interest or even a reply. Here are several of the recommendations that are within the power of FCC to implement:

FCC and NTIA should explicitly acknowledge the role of Section 7 of the Communications Act of 1934, as amended, and the intent of Congress to encourage new communications technology and services. These agencies should adopt transparent

⁵⁰ <http://www.foreffectivegov.org/node/2288>

⁵¹ <https://www.ieeeusa.org/about/>

⁵² IEEE-USA, "Improving U.S. Spectrum Policy Deliberations in the Period 2013-2017, November 13, 2012 (<http://www.ieeeusa.org/policy/positions/SpectrumPoilcy1112.pdf>)

procedures for determining which innovations are subject to this statute and should make readily available information on such proceedings. The FCC and NTIA should recommend changes in the statute in a timely way, if the current terms of Section 7 are deemed not practical.

Petitions for rule changes and clarifications are key issues in the regulation of the dynamic telecommunications industry. FCC should act on such petitions in a more transparent way, and make available information on petitions and their status on a consistent timely schedule.

FCC and NTIA should supplement their existing Technological Advisory Council (TAC) and Commerce Spectrum Management Advisory Committee (CSMAC), which consist mainly of representatives of major communications firms, with a new advisory committee that serves both agencies and focuses on independent review of options for resolving spectrum conflicts and identifying outdated policies. The new group should be modeled on the EPA Science Advisory Board and the NRC Advisory Committee on Reactor Safeguards and members should have the necessary security clearances to deal with issues involving classified federal government spectrum users, if so requested.

FCC and NTIA should have the resources to contract with the National Academy of Science's National Research Council (NAS/NRC), Federally Funded Research and Development Centers (FFRDCs) and private analysis contractors, to supplement their internal staffs on novel technical policy questions where they lack the appropriate internal resources.

“Ofcom Model”

Ofcom is the FCC's UK counterpart and its jurisdiction is very comparable.

There is even an FCC/NTIA-like bifurcation with a Cabinet Office committee⁵³ handling the NTIA/IRAC functions independently, although it is rarely discussed. While Ofcom has a Board appointed by the Secretary of State for Culture Media and Sport⁵⁴, a member of the UK's counterpart to the Executive Branch, the Board does not participate broadly in Ofcom actions as much as the FCC commissioners do. The Board provides strategic direction for the organization.⁵⁵ But the actual regulatory functions are performed by the

⁵³ UK Department for Culture Media & Sport, “The UK Spectrum Strategy: Delivering the best value from spectrum for the UK”, 10 March 2014 at Section 3.3 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/287994/UK_Spectrum_Strategy_FINAL.pdf)

⁵⁴ <http://www.ofcom.org.uk/about/how-ofcom-is-run/ofcom-board/board-procedures/>

⁵⁵ <http://www.ofcom.org.uk/about/how-ofcom-is-run/>

Ofcom staff leadership operating as the Policy and Management Board (PMB). PMB “is the decision maker on key policy and regulatory and organisation issues. Issues of greatest significance will be escalated to the Ofcom Board.”⁵⁶ Ofcom is not an ordinary UK government agency and its senior staff do not have civil service protections. (Note that most FCC bureau/office chiefs and many other senior officials are “noncareer” officials and also lack ordinary civil service protections.)

Like a corporate board of directors the Ofcom Board sets strategic policies and pays attention to “issues of greatest significance” but does not get involved in every decision of the agency. This is in great contrast to practice at FCC and probably is a key the source of FCC’s undercapacity compared to its UK counterpart.

It appears that the longstanding provisions of §5(c) are general enough to allow the Commission to create a group within FCC analogous to the Ofcom PMB to handle spectrum technical policy issues up to some level of controversy. This group could be composed of senior FCC managers or nonmanagers who focus entirely on this function. It could also include academics serving in such a role for a year or two - similar to the FCC’s present Chief Economist and Chief Technologist positions.

While key issues like the incentive auction and net neutrality need the input and active participation of presidential appointees, many of the issues – especially spectrum technical policy issues - do not requires such input and benefit little from the participation of political appointees and their personal staff. The key challenge would be to devise a workable definition of what type of proceedings could be handled by such a group under

⁵⁶ <http://www.ofcom.org.uk/about/how-ofcom-is-run/pmb/roles-and-responsibilities/>

delegated authority. Mr. Lazarus' previously cited concept of "benign" where "the proponents fully addressed any serious opposition" might be a good starting point.

Note that in the case of the correction of the experimental license rulemaking, Docket 10-236, that no party ever supported the inadvertent prohibition of experiments in passive bands and no party ever opposed reversion to the *status quo ante*. This would have made this issue "benign" in the Lazarus definition. It is unclear why this reconsideration took 2 ½ years from the original decision or 2 years from the reconsideration filing date, but an examination of the time flow will likely show that getting feedback on the draft from the Chairman and commissioners was probably 6 months to a year of the delay.

Note that an FCC spectrum policy analog of the Ofcom PMB with delegated authority for some spectrum policy decision would be analogous to the former FCC Review Board that existed from 1962 to 1996.⁵⁷ The Review Board was created under §5(c) to handle reviews of decisions of hearing examiners and to take oral arguments as necessary. In recent FCC practice such hearing have been rare so the Review Board was eliminated. But a Spectrum Technical Policy Board could be created under the same §5(c) provisions with a very different jurisdiction and as in the case of the Review Board the Commission would retain the power of *en banc* review.

Budget Issues

But organization issues are not the only source of FCC's short fall in spectrum policy decision making. **FCC is basically underfunded** even though its budget has been matched or exceeded by user fee collections (not including auction revenues) since

⁵⁷ J. O. Freeman, "Review Boards in the Administrative Process", *U. Penn. L. Rev.*, Vol. 117, p. 546

2009⁵⁸. Thus, FCC has in effect not received any tax revenues since that year. All fees are deposited in Treasury accounts and FCC can only spend what is explicitly appropriated by Congress -- with the minor exception that some auction income can be retained for auction-related expenses. In 2014 users fees collections were actually \$374M, greater than the appropriated budget of \$340M⁵⁹. FCC has also collected \$53,562,655,117⁶⁰ for the Treasury in auctions since 1994.

Figure 2 shows the total staffing appropriations of the Office of Engineering and Technology and the Wireless Telecommunications Bureau in the period FY 2010-15. We use this as a rough estimate of FCC resources committed to spectrum issues.⁶¹ While there is a modest increase, the author can recall when he was the 157th person hired in OET's predecessor in 1979 which now has a staff of 90!

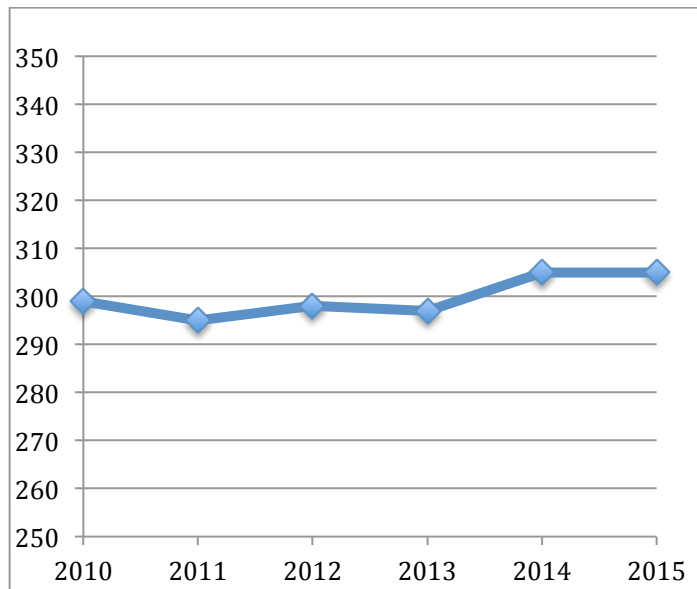


Figure 2: Total of OET and WTB staffing appropriations for 2010-15⁶²

⁵⁸ FCC Fiscal Year 2016 Budget Estimates Submitted to Congress February 2015 at p. 38 (https://apps.fcc.gov/edocs_public/attachmatch/DOC-331817A1.pdf)

⁵⁹ *ibid.* at p. 38-39

⁶⁰ *ibid.* at p. 31

⁶¹ In some years FCC has identified in its budget the resources allocated for “spectrum”. This may be a poor proxy for spectrum policy resources due to the fact it includes nontechnical broadcast content and ownership issues. It also has not been listed consistently in annual budgets.

⁶² FCC budget requests for FY 2011-2016 (<https://www.fcc.gov/encyclopedia/fcc-strategic-plan>)

FCC's present modest budgeting is part of a government-wide pattern and regulation in general is not popular in today's political climate. But *most* of FCC's actions do not put new burdens on industry as EPA is perceived by some to be doing. Most of FCC's actions create new technical and business opportunities and slowing such actions actually hurts economic growth! FCC even makes a profit!

While net neutrality is indeed very controversial and partisan, perhaps a way can be found to fund the technical spectrum policy side of FCC that has safeguards against transferring such funds to other more controversial parts of FCC jurisdiction.

It is interesting to note that the independent FCC has not publicly complained about its budget situation. It is obligated to submit its budget proposals to OMB for review but no law requires the Chairman and commissioners to defend OMB's determinations. In recent memory no FCC regulatee has ever appeared at a congressional appropriations hearing for FCC to ask for either an increase or decrease of FCC's budget although such practices happens for other agencies.

While CTIA and NAB opposed the FCC's recent "Field Modernization" cutback of spectrum enforcement, they did not speak out publicly on the pending FY2016 budget that was the root cause of the cutback. Regulated industries would benefit in real ways from timely FCC spectrum policy determinations and need to get involved in the budget process both with OMB and congressional appropriations committees. Entrepreneurial firms, in particular, need timely resolution of FCC deliberations on new technology before their funding dries up.

This problem is not new. In its Fourth Annual Report the Commission wrote

“To remedy this situation of understaffing, overload, and accumulation, as well as to provide more adequate and effective facilities for regulation, the Commission has recommended this year a substantial increase in its budget.”

A major change in funding is needed to get spectrum policy back on track but the impact on regulated industries will be negligible compared to their total cash flows since the current FY106 budget request is \$388M.⁶³ An increase of \$50-100M would be affordable in an environment where the cellular industry has revenues of about \$190B, the broadcast industry has revenues of about \$200B, and the telephone/ISP sector probably has comparable revenues - putting the total revenues of FCC-regulated industries in the \$500B range.

Conclusions

FCC’s spectrum policy decision-making throughput may have been adequate in 1934, but due to technical and legal changes since then the throughput is inadequate given the demands of today’s industry. The causes of this throughput gap are both organizational and funding issues. The decision making structure of FCC may be appropriate for parts of its jurisdiction, but fail to produce the capacity needed in the rapidly evolving spectrum technology area. Even the cellular industry, which has replaced the broadcast industry as the prodigal child at FCC, appears to have to choose whether it wants FCC attention for its spectrum needs or its interference problems. New technologies with long term potential have serious trouble getting timely attention at FCC.

⁶³ FCC Fiscal Year 2016 Budget Estimates Submitted to Congress February 2015 (https://apps.fcc.gov/edocs_public/attachmatch/DOC-331817A1.pdf)

A series of proposals, some from the author and some from other sources, are presented to address this issue. Most can be implemented without new legislation although several need or would benefit from increased FCC funding. Reasonable people could disagree on which proposals are most practical, but the key issue is to acknowledge that the undercapacity is present with the current FCC operating methods and the current budget and to understand the productivity shortfall and its malicious impact on US competitiveness in wireless technology as well as new services for American people and American economy.

Biography of Author

Michael J. Marcus (mjmarcus@marcus-spectrum.com) is director of Marcus Spectrum Solutions LLC, Cabin John, Maryland and an adjunct professor at Virginia Tech's Bradley Department of Electrical & Computer Engineering. He retired from the FCC in 2004 after nearly 25 years in senior spectrum policy positions. While at FCC, he proposed and directed the policy developments that resulted in the bands used by Wi-Fi, Bluetooth, ZigBee, and unlicensed millimeter-wave systems. He was an exchange visitor to the Japanese Ministry of Posts and Telecommunications, and has been a consultant to the European Commission and the Singapore regulator. He served in 2012–2013 as Chair of the IEEE-USA Committee on Communication Policy. In 2013 he was awarded the IEEE Communications Society Award for Public Service in the Field of Telecommunications. He received S.B. and Sc.D. degrees in electrical engineering from MIT and was elected a Fellow of the IEEE in 2004 “for leadership in the development of spectrum management policies”. He serves as Associate Editor of *IEEE Wireless Communications* where he writes regularly about spectrum policy issues for the technical community.